

ECF: The Sustainable Technology



Quality Paper
Clean Environment

 Alliance for
Environmental
Technology



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Clean Environment

Government organizations around the world recognize ECF's proven pollution prevention record and its contribution to sustainable ecosystem recovery. Both the U.S. EPA and the European Community have developed pulp and paper guidelines and regulations based on ECF bleaching as a core component of Best Available Technology, ensuring compliance with the International Stockholm Convention on Persistent Organic Pollutants.

ECF bleaching — based on chlorine dioxide — is the superior technology choice for sustainable pulp and paper manufacturing. Papermakers and paper users alike desire ECF's superior product quality, resource conservation attributes and compatibility with sustainable Minimum Impact Manufacturing.

Fueled by continued strong government support and proven environmental integrity, new paper mills striving for quality paper and a clean environment will use sustainable, ECF-based bleaching technology.

ECF: Core Component of Minimum Impact Manufacturing

A minimum impact pulp and paper mill

- minimizes the number of trees used to make a piece of paper
- maximizes energy production from biomass
- minimizes water consumption, solid waste and air emissions

and also...

- makes high quality paper that is easily recycled
- treats and disposes of waste optimally
- creates sustainable value to society

The vision of Minimum Impact Manufacturing has captured the imaginations of industry leaders and the environmental community alike.

ECF is integral to achieving that vision of minimum impact. **ECF manufacturing produces the strongest fibers, while conserving forest resources and enhancing recyclability.**

In combination with enhanced pulping strategies, ECF manufacturing has a higher yield, using the least amount of wood compared to other bleaching processes. And finally, ECF is compatible with, and at the leading edge of, closed loop strategies for minimizing wastewater from bleaching. Along with efficient wastewater treatment, closed loop strategies are providing optimal solutions for protecting and sustaining the receiving water ecosystem.

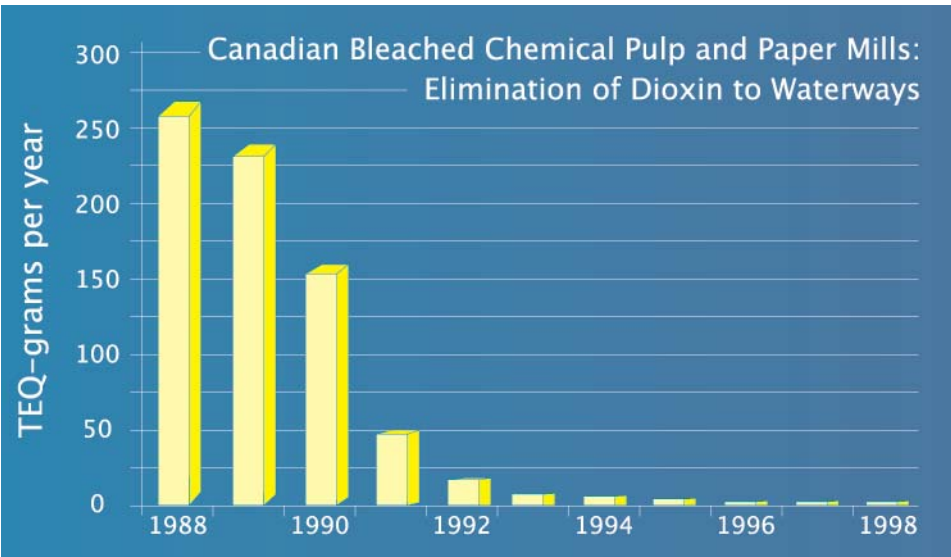


Four-stage ECF bleaching fiberline. Photo by Tom Grow, courtesy of Andritz AG.

ECF: Proven Pollution Prevention

Experts from industry, academia, interest groups and government agree that pollution prevention means more than stopping pollutants from entering the eco-system or end-of-pipe clean-up after the fact. Pollution control and waste management fall short of true prevention: stopping pollution before it starts.

In the late 1980s, trace levels of dioxin, an inadvertent by-product of the prevailing pulp bleaching process, was discovered in the water and fish downstream of pulp and paper mills. The international pulp and paper industry quickly moved to voluntarily implement a comprehensive, multi-faceted strategy that has virtually eliminated persistent, bioaccumulative and toxic substances. **The key component of their successful pollution prevention strategy was ECF bleaching — a technology that prevents the formation of dioxin.** Worldwide experience shows papermakers have virtually eliminated dioxin discharges.



"A notable accomplishment occurred when the pulp and paper industry changed its process for pulp bleaching by substituting chlorine dioxide for elemental chlorine. This substitution virtually eliminated the production of dioxins from pulp and paper mills"

International Joint Commission

"... in Western Europe, mills stopped the use of molecular chlorine for bleaching of pulp [i.e. implemented ECF bleaching]. This means the formation of chlorinated dioxins and furans has virtually ceased..."

European Commission

ECF: Compatible with a Sustainable Eco-System

"Studies comparing ECF and TCF effluents confirmed the absence of significant differences in biological effects in the aquatic environment"

**Institute for Papermaking,
Darmstadt Technical
University, Germany**



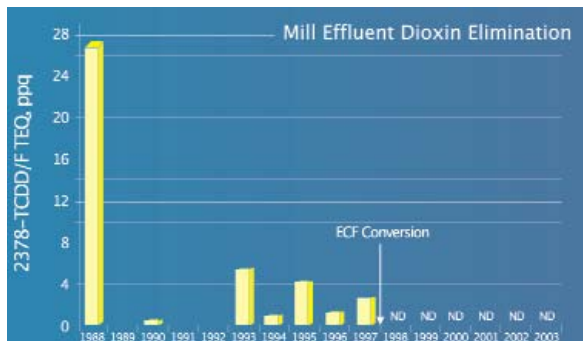
Treated wastewater, from well-managed pulp and paper mills using ECF bleaching, is virtually free of dioxin and persistent, bioaccumulative and toxic substances.

The remaining chlorine-containing organic substances resulting from ECF bleaching are similar to substances found in nature, degrade naturally and do not persist in the environment. Research shows they present a negligible environmental risk to aquatic ecosystems.

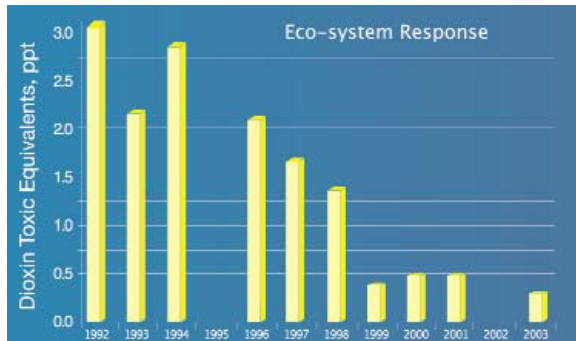
This research has been confirmed in eco-system simulations comparing wastewaters from ECF bleaching to other non-chlorine bleaching concepts, including those called Totally Chlorine-Free (TCF).

ECF: Proven Pollution Prevention -The Maine Story

Implementing Elemental Chlorine-free (ECF) bleaching, based on chlorine dioxide, produces dramatic results. As shown below, dioxin is virtually eliminated at a pulp and paper mill in the state of Maine, USA, and tissue concentrations of dioxin in Smallmouth Bass downstream from the mill decline greatly.



Final Mill and Bleach Plant Effluent 2378-TCDD/F
ND - Not Detected (DL = 0.3 - 6.0 ppq)



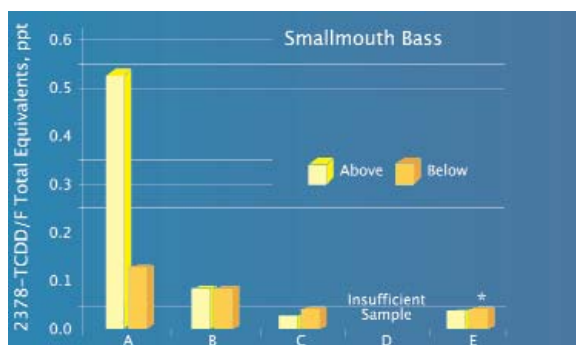
Fish Tissue Concentrations - Wet weight basis,
ND assigned value of "0"

"The bleached kraft pulp and paper mills in Maine are no longer discharging dioxin"

**Maine Dept. of Environmental Protection
May 3, 2005**

In 1997, the State of Maine passed the toughest standard in the US, a unique law prohibiting its bleached kraft pulp and paper mills from discharging dioxins into receiving waters. More importantly, the law requires that fish tissue concentrations of dioxin measured below each mill not exceed those of fish sampled at an upstream reference site.

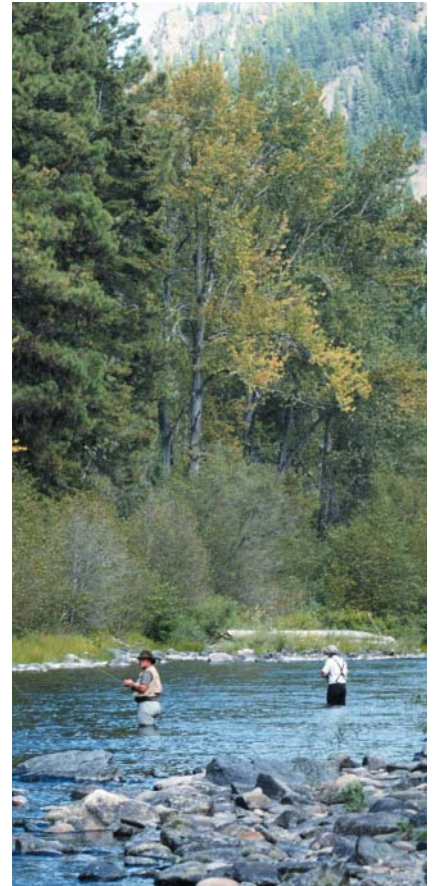
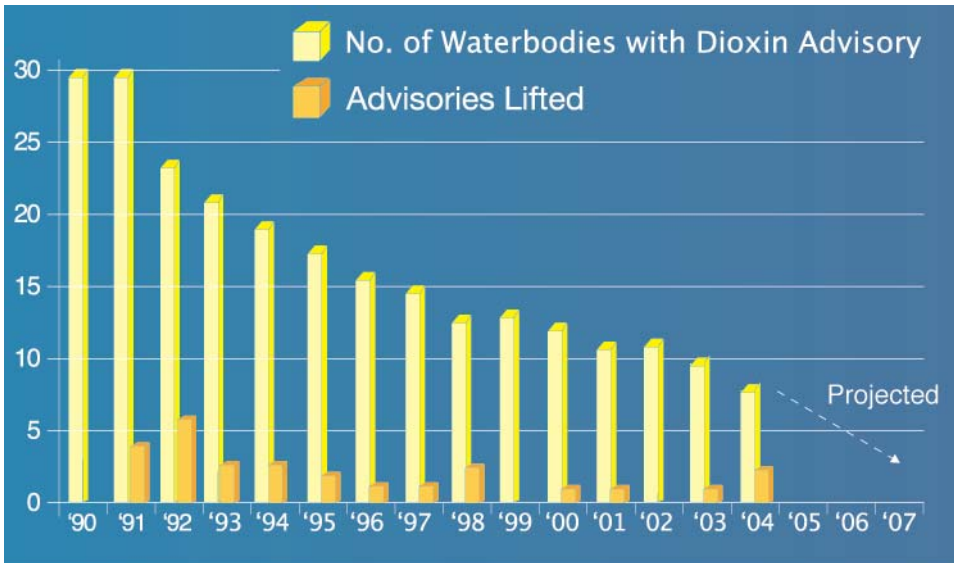
In 2005, the State of Maine deemed the five mills to be in compliance with the law. As indicated below, the state's ECF-bleached kraft pulp mills no longer discharge dioxin into receiving waters. ECF is a cornerstone of sustainable pulp production, as demonstrated by this unprecedented level of analysis and assessment of performance.



Average Fish Tissue Concentrations Upstream and Downstream of Maine's Bleached Pulp Mills: (2378-TCDD/F expressed as Total Equivalents) - Wet weight basis, ND assigned value of "1/2 DL" * Statistically significant at $p < 0.05$

ECF: Sustainable Eco-System Recovery

Since 1990, state authorities in the U.S. have cleared, i.e., lifted, dioxin advisories from 27 eco-systems downstream of pulp mills, representing 90% of the 30 such advisories in effect in 1990. In 2005, in the U.S., only 8 eco-systems remain with a dioxin advisory downstream of a bleached pulp and paper mill. The U.S. EPA predicts that over time all remaining dioxin advisories downstream of U.S. pulp and paper mills should be lifted following conversion to ECF bleaching.



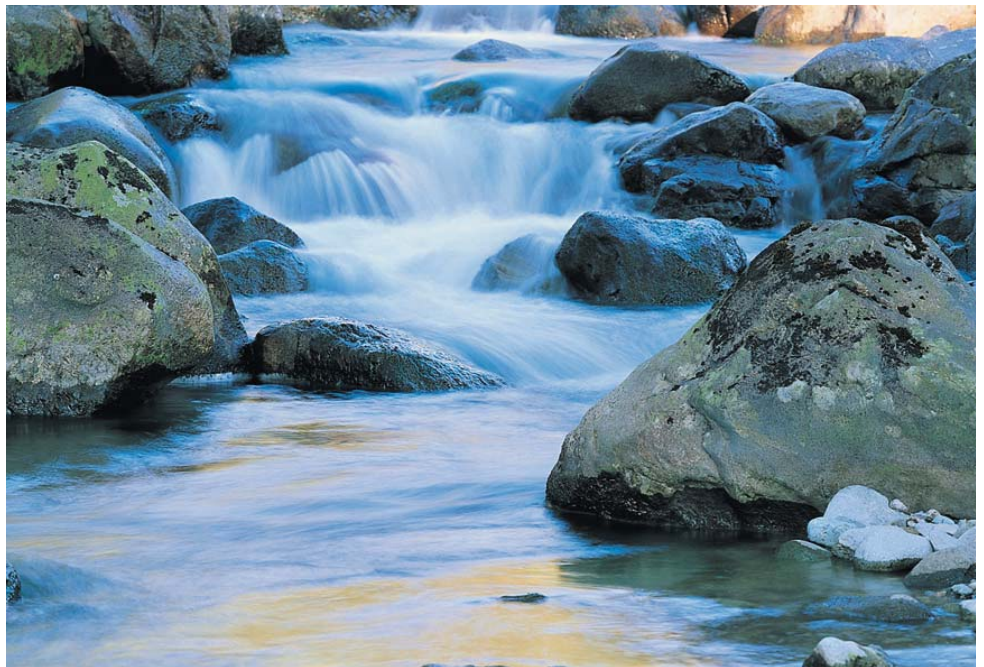
"We were especially pleased that the 'best available technology' selected for the papergrade kraft mills was an Elemental Chlorine-Free (ECF) Technology"

**Carol Browner,
former U.S. EPA
Administrator**

ECF: The Best Available Technology

During the 1990s, governments, responding to the environmental concerns posed by persistent, bioaccumulative and toxic compounds, developed new regulations for their respective pulp and paper industries. A common feature of many of these regulations and guidelines is the concept of Best Available Technology (BAT).

Recognizing its superior performance, the U.S. and the European Community developed pulp and paper guidelines and regulations based on ECF bleaching as a core component of BAT. These regulations and guidelines ensure compliance with the International Stockholm Convention on Persistent Organic Pollutants, the POPs Treaty.



ECF: Handled with Responsible Care®



Manufacturers of sodium chlorate — the raw material for chlorine dioxide — and designers of chlorine dioxide manufacturing facilities subscribe to the codes and principles of Responsible Care®.

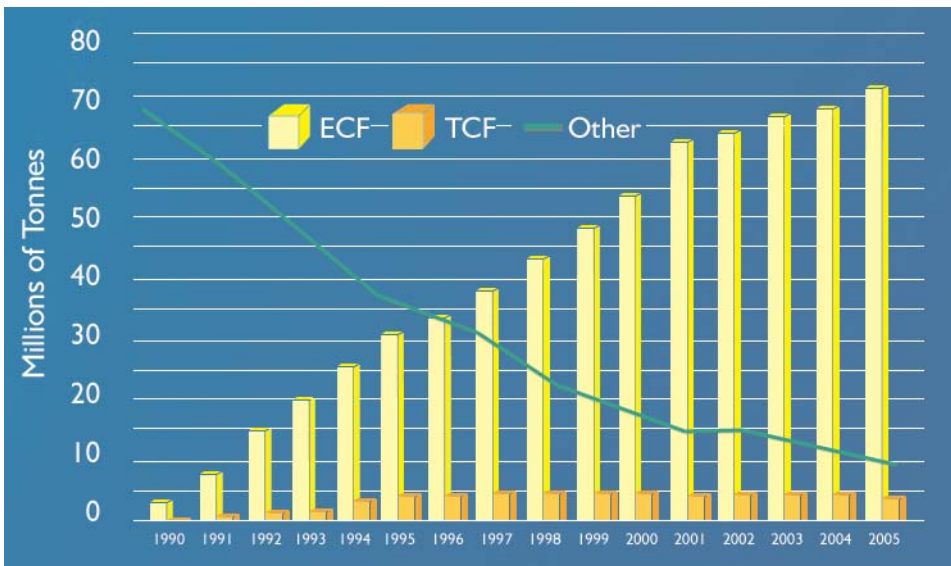
The U.S. pulp and paper industry manufactures chlorine dioxide in accordance with the U.S. Occupational Safety and Health Administration's (OSHA) Process Safety Management requirements, and protects employees and local communities through Emergency Response and Risk Management Plans.

This commitment from suppliers, designers and manufacturers has led to over 50 years of safe industrial experience with chlorine dioxide.

These codes include:

- community awareness and emergency response
- pollution prevention
- process safety
- transportation and distribution
- employee health and safety
- product stewardship
- security

ECF: Leading the Market



Demand for ECF continues to accelerate. In 2005 ECF held the highest worldwide market share for bleached chemical pulp at greater than 85% or more than 70 million tonnes. ECF market share continues to grow throughout the world and will increase dramatically over the next five years as new mills planned in Eastern Europe, South America, Australia, China and South East Asia will incorporate ECF bleaching.

"ECF bleaching allows production of kraft pulps that meet the highest requirements with respect to strength, brightness, brightness stability and cleanliness"

Jan Rennel,
Jaakko Pöyry Consulting AB,
Stockholm, Sweden

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